

MOST IMPORTANT FACTORS INFLUENCING ROAD TRAFFIC ACCIDENTS AND EFFECTIVENESS OF PUBLIC INVESTMENTS IN ROAD TRAFFIC ACCIDENT REDUCTION PROJECTS IN LATVIA

Liena Adamsone, Dace Parupa
Riga Technical University, Latvia

Abstract

Transport industry plays a very important role in each country's development. An efficient industry that facilitates the movement of commodities, products and people is therefore vital to the growth of the country. In the European Union transport industry makes up about 7% of the European gross domestic product, about 7% of all jobs, 40% of investments by member states and 30% of energy consumption. However, notwithstanding transport industries positive influence of the nation's economic welfare, the automobilization causes also such negative externalities as the air pollution, noise, traffic jams and road traffic accidents (RTA). According to statistics, in 2007, 43000 people had died in road traffic accidents in the European Union - looking at it another way, it is the equivalent to a five medium-sized airplane disaster happening in Europe per week. Also in Latvia during the recent years, the number of the registered RTAs has increased. During four years it had grown by more than 25%. The greatest increase was in the period from 2006 till 2007, when the number of RTAs grew by 17%. In 2006, RTAs caused economic damages in the amount of LVL 217,12 million (EUR 152,6 million). High number of RTA has become one of the major problems in European Union. The aim of this article is to identify and analyze the factors, influencing road traffic accidents, and analyze the efficiency of the investments into the reconstructed road sections. For better interpretation there is: elaborated a model of interaction between factors which influence road traffic accidents and efforts which should be made to reduce amount of RTAs; there is also made an analyze about the change of RTA in some reconstructed road sections in Latvia. An analyze showed that no road reconstructions with the aim to reduce the number of RTAs are as effective as the change of the traffic participants' behavior. At the end of the paper are given proposals for minimizing the number of RTAs. Given analysis can be used in future planning of needed investments for reconstructing of motorways and investments for changing human behavior.

Key words - Transport industry, road traffic accidents, losses of national economy, factors influencing road traffic accidents.

European Union (EU) market is built on four freedoms of movement – the freedoms of movement of goods, services, persons and capital. At least two of these freedoms depend largely on physical mobility. The increasing mobility of people and goods has played an essential role in EU economic growth, and our social and regional cohesion. Over the last decades, increasing mobility has been at the core of economic growth in the EU. Also competitiveness of the European manufacturing and services industries is directly dependent upon the mobility of goods and persons. After a prolonged period of stagnation, the transport policy of the European Union (EU) has developed very rapidly during the last 15 years. In view of the growth of economic welfare, entailing the increase of the number of vehicles and intensity of traffic, one must take into consideration also the increase of the number of RTAs [1]. In this respect, the EU member states have set the aim to minimize the number of accidents and fatalities- target is to reduce the

number of road fatalities by 50% by 2010 compared with 2001.

During the last seven years, the overall population in Latvia has decreased by 4%, but at the same time the number of passenger cars registered during the same time has increased by 72.2%. As the result of increase of the number of vehicles, the annual average traffic intensity on the state motorways has increased by 97%, including freight transport by 36%. Based of the abovementioned statistics, Latvia has reached the level of automobilization 300 vehicles per 1000 people. According to the opinion of the specialists of Swedish Road and Transport Institute, the level of automobilization, exceeding 300 cars/1000 people, is to be considered a relative saturation level of automobilization. In such circumstances, for instance, in Sweden road safety alongside with environment protection is made state priority.

The increase of the number of vehicles and drivers entails also negative consequences, such as:

- increase of environment pollution;
- increase of the number of road traffic accidents.

The worst situation in Latvia, in traffic safety was in the year 1991, when 923 people died in road traffic accidents (RTAs). This tragic statistics and rapidly developing contacts of Latvia with the European countries, made more acute the issue of ensuring European level safety on Latvian motorways. In 1994, in Latvia, within the framework of the Transport Development Program, the first Road Traffic Safety Program was developed. Implementing the activities included therein, already in 1998, the number of fatalities decreased 1.47 times, compared to the year 1991.

However, even if the number of RTAs has decreased since 1991, still the number of the registered RTAs has steadily increased during the last four years (2003–2007). During these four years, it has grown by more than 25%, and the greatest increase has been in the period from 2006 till 2007 – during one year the number of RTAs has grown by 17%. Even if the number of RTAs has grown in the recent years, the total number of fatalities in RTAs has fallen by 18% during the last four years. The total number of injured also has decreased by 5% during the last four years.

Road crashes cost approximately 1 to 3 percent of a country's annual Gross National Product (GNP). These are resources that no country can afford to lose, especially those with developing economies. Economic damages, resulting from RTAs, in Latvia amount to 1.55% of the Gross Domestic Product.

Based on the overall increase of automobilization and the aims set by the EU in the promotion of road safety, the Ministry of Transport has given a special importance and priority to the issue of road safety. The achievable objective is safe traffic on safe roads, where qualified drivers drive technically safe vehicles. In further document there will be described each of 3 safe traffic elements (factors):

1) Motorway infrastructure, its condition and the organization of traffic (safe roads). Under term "safe roads" we understand such road factors: lighting, view obstructions, recognizability, signs, signals, surface character, dimensions and protective devices. All factors are subject to modification by outside influences such as the road surface that becomes slick from rainfall. The total density and coverage of motorway

network in Latvia is sufficient, and the length and situation of motorways allows to reach populated places. However, it must be admitted that the technical condition of the motorways is unsatisfactory and inadequate to the requirements of safe and continued traffic. At the current insufficient level of motorway maintenance and development financing, along with the increase of the actual intensity of traffic flow and the proportion of heavyweight vehicles, the quality of the motorways significantly decreases each year, and a continuing degradation of the motorway network is going on. As the shortage of financing hinders the restoration of black road surfaces in the normative amount, the quantity of road surfaces in poor condition increases each year, accordingly increasing the amounts of the postponed renovation works. Along with the increase of the actual intensity of vehicle traffic flow, exceeding the predicted increase, and the lack of funds for renovation and reconstruction of road surfaces, as well as the construction of new roads, the qualitative indicators of the motorways significantly decline each year. State and municipal road maintenance costs are financed from the state and municipal budgets, but the wish expressed by Latvia to be one of the EU member states and its participation allows and will allow to receive additional co-financing for the road investment projects (ISPA, Cohesion Fund, European Regional Development Fund). In 2008, the state budget expenditures for the state motorway fund program are set already at the amount of LVL 236.4 million. 30% of this financing are allocated for special purpose subsidies for financing of municipal streets and roads, but the remaining 70% or LVL 165.5 million – for financing of state motorways. This sum in its turn is divided into maintenance and management of state motorways (LVL 73.6 million) and capital expenditures for the renovation of state motorways (LVL 91.9 million, 12 millions of which are provided for state 2nd grade motorways and regional support). It is planned that starting from 2009, as much as LVL 35 million will be channeled for state 2nd grade motorways. In the period from 2008 till 2013 it is planned that transport infrastructure projects will be realized for the total amount of LVL 2.5 billion, including LVL 724.8 million investments into motorways, LVL 727.1 million – into railway, LVL 269.3 million – into aviation, LVL 494.7 million – into ports [2]. Even with the increase of the financing of state motorways from

the principal state budget in the last eight years, still, in view of the current growth of traffic intensity, the reconstruction of roads proceeds too slowly. According to the calculations by the Ministry of Transport, the financing, allocated for the maintenance of state motorways, including their renovation, during the last 15 years, has been significantly smaller than normatively necessary. The overall condition of the motorways becomes worse each year, causing dissatisfaction among people – drivers, taxpayers and local authorities. The accumulated repair deficit, calculated in the prices of the year 2006, exceeds LVL 4.26 billion, but the projection of the state motorways financing for the state budget subprogram 23.06.00 "Management, Maintenance and Renovation of State Motorways" in the period from 2007 till 2013 will allow to channel only LVL 1.29 billion for the state motorways. Evaluating the actual situation in the road traffic infrastructure, as well as the projection of the state budget financing for motorways, one has to admit that there are good prerequisites for the use of public-private partnership models for the development and maintenance of motorways and their infrastructure. It is further confirmed by the existing practice in other countries and a positive experience in the realization of public-private partnership projects especially in the transport industry.

2) Technically safe vehicles. Under term "technically safe vehicles" we understand such vehicle factors: equipment condition, view obstructions, distractions, instruments, signaling devices, control sensation, comfort, automatic controls and devices, weight, performance, dimensions and stability, automatic cruise control, navigation systems, existence of seat belts, airbags. In Latvia new transport vehicles compiled 18% of total amount of first time registered vehicles in year 2000, but in year 2006 it was already 26%. The number of transport vehicles is growing with economic growth across Europe, leading to increased environmental impact. But with Europe's economic recession transport vehicles selling industry has stopped. Amount of new transport vehicles effect average age of a car. In Europe average age of a car is eight years old [3], but in Latvia it is 11 years old. The average age of a car speaks also about the cars owner possibility to repair car. Many car owners are not prepared to pay the premium rates of the authorized repair network to maintain their vehicles. Car repair and maintenance are key cost

issues for most motorists, and it is normal that car owner have choice to choose affordable service price for his pocket. To ensure better service quality, there should be more regulations for services about the individual qualities of cars. A well-designed and well-maintained vehicle, with good brakes, tires and well-adjusted suspension will be more controllable in an emergency and thus be better equipped to avoid collisions. It is interesting, that the color of a car also plays a role in determining whether the vehicle will be involved in a crash. A study of 31,000 crashes in Sweden found that black cars were involved in 22.5% of the crashes even though black cars made up only 4.4% of the vehicle population. This means that black cars were 5 times more likely to crash. According to the same study, the safest car color was pink [4]. However there are no countries where black cars are illicit in usage.

3) Human factor Under term "human factor" we understand such factors: decision making, driving skills, demographics (age- very young people may see something sooner than older people, younger drivers tend to drive fast, but older drivers tend to drive slow; gender), distraction, drugs and alcohol, driving experience, driver training, sensory capabilities, judgment, attitude, alertness, health, poor eyesight, customs, habits, familiarity with vehicle and environment, fatigue, inattention, response to the unexpected, risk-taking behaviors, stress, panic, and hyper vigilance. Several conditions can work together to create a much worse situation, for example [5]: combining low doses of alcohol and cannabis has a more severe effect on driving performance than either cannabis or alcohol in isolation, or taking recommended doses of several drugs together, which individually will not cause impairment, may combine to bring on drowsiness or other impairment. This could be more pronounced in an elderly person whose renal function is less efficient than a younger person's. Human factors are without doubt the most complex and difficult to isolate as they are almost all very temporary in nature. What existed at the time of the accident may not exist moments later. There are made some investigations about human behavior, but information of its impact and importance is not enough. For example, higher speed increases risk of occurrence of an accident because it shortens the period of time for drivers to take decision in critical situation and to perform manoeuvre of escape. In the accident with pedestrians the possibility that the

pedestrian will be killed increases rapidly if the speed at the moment of crash is higher. For example, if the speed of the vehicle at the moment of crash is 50km/h instead of 40km/h the risk that the pedestrian will be killed increases 2,5 times [6]. If speed is 80 km/h, in reaction time (1 second) driver can make approximately 22m. Cars travel to stop is 35m. In whole- 57m. It means that if somebody runs 35 m afore a car – there will be a crash with a victim. But if a speed in this situation would be 50 km/h - in reaction time car makes 14m, but cars travel to stop is 13m. It means in whole 27m- and in this situation there is no accident. European statistics shows that approximately 1/3 of all RTA with killed persons happen because of breaking speed limit [7].

To evaluate impact of above mentioned factors the authors of this paper have made an analyze to some reconstructed road sections. An analyze in reconstructed road sections is made upon the changes of number of RTAs. Authors of this paper analyzed such reconstructed road sections in a period 2005 - 2007:

- in 2005, was made reconstruction of Balozi crossing (installation of traffic-lights) on motorway A7 Riga- Bauska- Lietuvas border)10 km (Figure 1);
- In 2006, was build a regulated pedestrian crossing at Aizkraukle railway station on the motorway A6 Riga- Daugavpils- Kraslava- Byelorussian border (Paternieki) 89-90km (Figure 2).

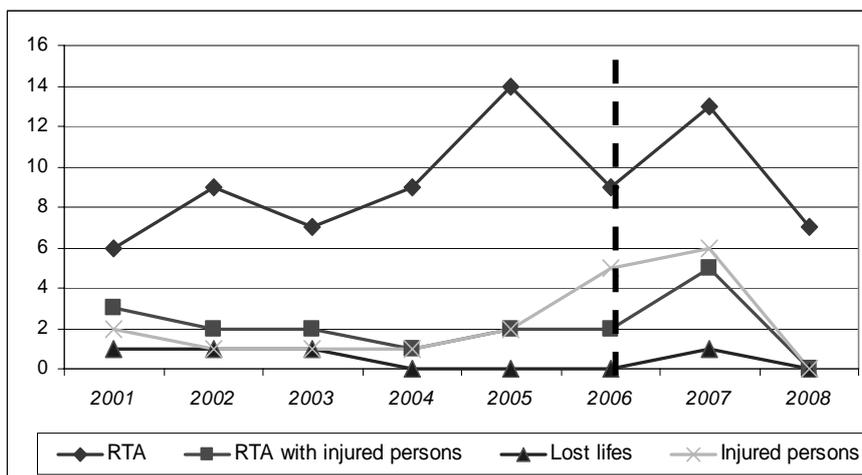


Fig. 1. RTAs on the motorway 10km (Balozi crossing) in period 2001 – 07.2008

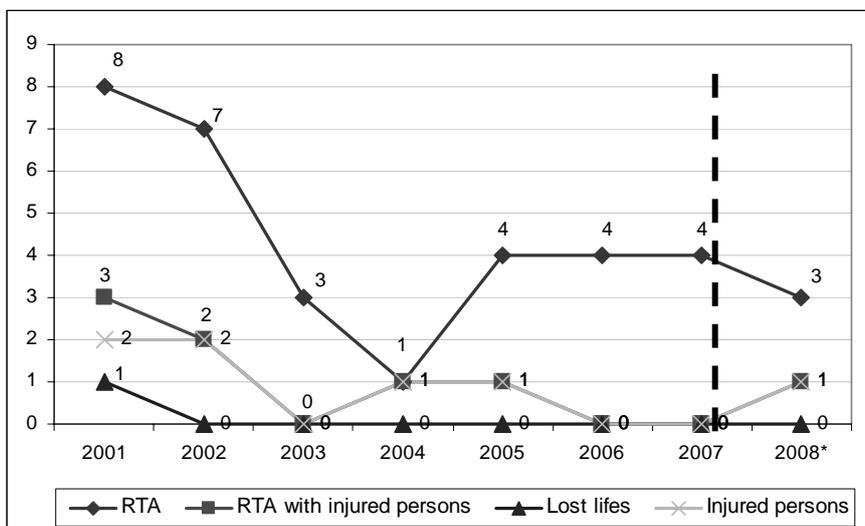


Fig. 2. RTAs on the motorway A6 89-90km (Aizkraukle) in period 2001 – 07.2008

Analyzing RTA dynamics in the abovementioned crossings (Figures 1 and 2), we can see that the overall number of RTAs in both reconstructed road sections has decreased from 2001 till 2008. However, evaluating the number of RTAs which was right before the making of the investment (burden line), we can see that the number of RTAs has not fallen dramatically, but – quite the opposite – has remained on the previous level or even slightly grown. But, analyzing the statistics of RTAs with victims and injuries, we can see that the severity of accidents falls. Although the actual data show that the number of RTAs has not changed after the making of investments, still, considering the increase of the number of vehicles and road traffic intensity, it can be considered that the reconstruction of the pedestrian crossing has given a positive result. The same situation is in most of all reconstructed road sections in Latvia.

However, on the basis of the abovementioned, as well as on the State Audit Office of Latvia, Audit Report Nr. 5.1-2-7R/2005 (09.06.2006.), it can be concluded that in most cases in comparison with the situation before reconstruction, the number of persons, injured in road traffic accidents decreases, but the number of accidents has not decreased.

Two hypotheses can be put forward:

1. the quality and effectiveness of the reconstruction works are not sufficient.
2. conditions each year controls Road Traffic Safety Directorate of Latvia and it can't be the main factor causing RTA.

The abovementioned leads to the conclusion that no road reconstructions with the aim to reduce the number of RTAs are as effective as the change of the traffic participants' behavior.

A 1985 report based on British and American crash data, found that driver error, intoxication and other human factors contribute wholly or partially to about 93% of crashes [8].

Nowadays human factor is involved in between 70 and 90% of traffic accidents, well above environmental factors, which are involved in 15 to 35%, or directly vehicle-related causes, which account for 4 to 10% [9]. It must be in the centre of attention of all society as well as in the centre of attention of particular sciences.

Most of accidents result from human error and carelessness on the part of the drivers or pedestrians. However, the probability of occurrence, and its severity, can often be reduced by

the application of proper traffic control devices, and good roadway design features. The success or failure of such control devices and design specifications however, depends extensively upon the analysis of traffic accident records at specific locations. It has long been recognized that the most effective means towards accident reduction lies in a systematic and scientific approach based on the use of accurate and reliable traffic accident data.

On the basis of the abovementioned, the authors of this publication have made a model which could help specialists to work with this problem and to prevent RTAs (figure 3).

Needed efforts, which have to be made to reduce amount of RTAs (explanation to figure 3):

1. Increasing of drivers subjective factor:

a. It is important to construct more roads with circular movement;

b. to realize wide control on roads (Presence of real or dummy policemen, photo and video radars)

c. perform road safety audits

2. Perform more activities & campaigns with purpose to change drivers and pedestrians behavior:

a. To educate and to train road users to behave safe – create new instructional materials for schools and integrate this materials in obligatory school subjects. Teaching safety skills to children can provide lifelong benefits to society, but should be seen as a long term intervention strategy;

b. To create public opinion about safe behavior based on actual investigations about each factors importance;

c. To enforce the road users to behave safe;

d. Parents should speak with their children about road traffic and how to act in special situations;

e. Train how to afford first aid to injured persons;

3. Improve technical construction of vehicles:

a. To advance brake dynamometers work;

b. Improve car lighting elements

c. Improve cars safety elements

4. Reduce old cars on Latvian roads- it is needed to work out countenance and motivation system for drivers to change old cars on new cars;

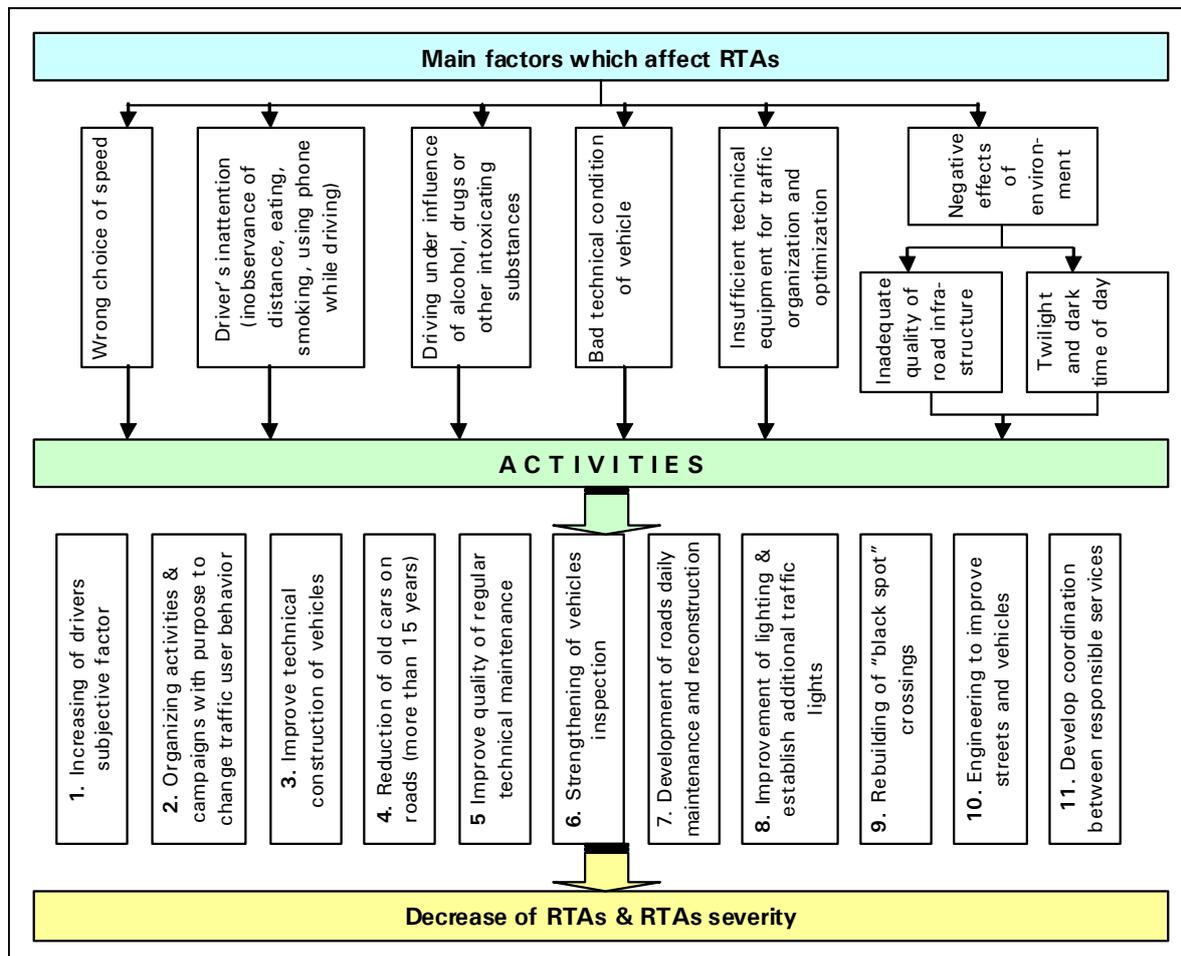


Fig. 3. The model of reduction of the amount of RTAs

5. Improve quality of regular technical maintenance:

- a. Guarantee for repayments;
- b. Licensing of services;

6. Strengthen vehicle inspection. It is needed also in future to carry on vehicle technical control, registration and certification;

7. To carry on roads daily maintenance and reconstruction:

- a. To carry on reciting of "black spots" and improve their determination;

- b. To carry on audit of roads always and after reconstruction of roads, establish regular audit groups;

- c. Detect and correct of locations with a high incidence of wet weather accidents utilizing

8. Improve lighting and establish additional traffic lights to improve quality of roads – Swedish example shows that full lightning of road helps to avoid from RTA for more than 62%,

because more than ½ of RTA happens in dark time of day.

- a. Build new pedestrian crossings only with extra lightning;

- b. To produce new designs of reverberates so that each person wants wear them;

- c. To place more self reflecting elements on roads so that each person can see where are road borders, crossings, or other important elements and warning signs;

- d. State and municipalities have to ensure their citizens with qualitative roads where are enough space for cars and pedestrians so that each of them feel safe.

Important to establish additional traffic lights on crossings of important roads and where pedestrians walk frequently:

- e. All traffic lights in one common net where person in charge can regulate it;

f. To hew out trees and bushes which grows next to roads so that visibility of road is burden;

9. Rebuilding of "accident black spot" crossings and installation of needed road signs. Make new pedestrian crossings. For example, the use of road signs and markings to channelise traffic through complex intersections or to provide safe waiting areas for turning vehicles can often result in substantial reductions in accidents.

10. Engineering to improve streets and vehicles. For example, 1) there are no seat belts specifically designed for children, 2) most pedestrians are hit by the front of the car, so the most common sites of injury are the head and lower limbs. The bumper contacts the lower limbs, and the body then wraps itself around the car with the head finally hitting the lower windscreen or bonnet. One proposal is to set bumpers lower, so that the femur and tibia rotate together on impact, avoiding the lateral stress on the knee that can result from femoral rotation alone. Bumpers should also contain an extra layer of energy absorbing material to reduce the impact force. Bonnets should be more than 10 cm clear of underlying structures to ensure flexibility if struck by a head. Other ways to provide clearance are airbags in the region of the lower windscreen and pop-up bonnets [10].

11. Develop coordination between responsible services (roads police, emergency medical services, fire-brigades, etc.) and coordination between them:

a. Road police isn't just for giving administer punishment, but also for improvement of traffic management to help drivers and pedestrians to get to needed destination;

b. Improve technical equipment of responsible services (also communication network);

c. Improve location of responsible services, because first 25 minutes after RTA are most important;

d. To ensure enough personal in each station/ brigade.

It is also important to improve communication system on roads:

e. To ensure all motorways with telephone communications in solitary cases;

f. To establish integrated database with geographical data, where catching telephone signal ambulance or police can get information about the precise place of RTA. In this system there should be an option were ambulance car can change signal of traffic lights to get faster to needed place.

Realization of above mentioned activities in the field of road safety is significant, because these activities will reduce not only the amount of RTAs, but also traffic accident costs of the expected loss of net production of persons killed or crippled in traffic accidents, hospital treatment of injured victims and costs caused by the road users themselves.

It is also important to realize all mentioned activities together all the time so that all factors, which affect RTAs can be prevented

References:

1. Potočnik J., Making the European transport industry "greener, safer and smarter" to boost our industrial competitiveness, Ljubljana, 21 April 2008 http://209.85.229.132/search?q=cache:jM1OUJPNQosJ:ec.europa.eu/commission_barroso/potocnik/news/docs/20080421_speech_transport.pdf+Transport+industry+in+EU&hl=lv&ct=clnk&cd=3&gl=lv
2. http://www.ldz.lv/dc/lv/aktuala_informacija/Transporta_nozares_preses_apskats/newspapers_in_latvian/Neatkariga_rita_avize/19854
3. Zabalaga C., FIA Response to the Commission Report on Block Exemptions, Fédération Internationale de l'Automobile, Brussels, 29 May 2008
4. <http://www.landtransport.govt.nz/fascinating-facts/safe-vehicle-colours.html>
5. http://en.wikipedia.org/wiki/Car_accident#cite_note-trl1-18#cite_note-trl1-18
6. Lāma A., Influence of human factor on road traffic safety in Latvia, presentation, Riga, 2007
7. ADONIS Final Report, 1998.
8. http://en.wikipedia.org/wiki/Car_accident
9. Montoro L., The human factor is present in at least 70% of traffic accidents, Madrid, 27 May 2008
10. <http://jrsrsmjournals.com/cgi/content/full/96/10/475>